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ABSTRACT

Data released in several reports have raised concerns regarding the status of undergraduate mathematics in two-year colleges, four-year colleges, and universities. The purpose of this digest is to review current trends in mathematics courses and instruction in higher education. Discussed are concerns regarding undergraduate mathematics programs and courses; types of programs and activities developed with precollege schools and students; current developments in college mathematics programs, courses, and materials for mathematics majors; and current developments in college mathematics programs, courses, and materials for nonmajors. Selected sources of information on college level developments in mathematics are listed. A list of 12 selected references is provided. (CW)

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RECENT DEVELOPMENTS IN COLLEGE MATHEMATICS PROGRAMS AND COURSES

Why have there been concerns regarding undergraduate mathematics programs and courses?

Data released in several reports during the past three years have raised concerns regarding the status of undergraduate mathematics in two-year colleges, four-year colleges, and universities.

Student interest in majoring in mathematics has been declining. The percent of freshmen enrolling in mathematics has declined sharply compared to enrollments during the early 1960's. The percentages of minorities, women, and disabled students entering mathematics programs also continues to be low.

Student interest in majoring in mathematics continues to decline while students are enrolled in college. Over 40 percent of the students who enroll as science and mathematics majors change to a non-science or non-mathematics major. Of those who continue in mathematics, a high percentage of students decide to end their studies at the undergraduate level.

At a time when a level of mathematics literacy is important for all students, non-mathematics majors usually do not enroll in a college mathematics course unless enrollment is required by their program or the institution; nearly 30 percent of colleges and universities do not require any enrollment in mathematics.

Several reports have been issued calling for needed changes in undergraduate mathematics programs and courses. Reports have included those of (1) The National Science Board (1986), (2) workshops sponsored by the National Science Foundation (1989) related to undergraduate mathematics and mathematical sciences and (3) reports published by several professional associations including The Mathematical Association of America and The National Council of Teachers of Mathematics.

These reports stated that many program and course changes are needed. Changes recommended include the following:

1. Programs and relationships with pre-college schools and students to increase the number and quality of entering students;
2. courses, curricula, and quality of instruction;
3. use of technology;
4. programs to attract minorities and women to mathematics; and
5. programs to retain students in mathematics majors and to attract others to mathematics majors.

What types of programs and activities have been developed with precollege schools and students?

Colleges and universities have established a variety of programs that involve precollege schools and students. While the institutions have provided some of the financial support for these programs, the National Science Foundation (1988) and business and industry have also provided support. Among the current programs are the following:

1. Advanced Placement Courses.
2. Summer programs for able students.
3. Summer programs for underrepresented groups.
4. Special courses during the academic year for able students and underrepresented groups.
5. Providing guidelines and testing students for mathematics knowledge and skills needed for college study.

These programs have been designed to increase the percentage and number of students entering mathematics programs and to reduce the number of students taking remedial courses at the college level.

National data indicate these efforts have not improved the overall decline of interest in mathematics as a field of study. Data indicate there has been an effect in some states, such as Ohio, of reducing the number of students who are required to take remedial courses at the college level.

What are some current developments in college mathematics programs, courses, and materials for mathematics majors?

Recent program and course developments for mathematics majors have stressed several ideas and practices. These have included: (1) reorganization of content; (2) selection of new content; (3) increased emphases on communication skills; (4) increased emphasis on use of applications; (5) increased laboratory work in mathematics; (6) inclusion of more content and experiences related to applications, and (7) attempts in some programs to reduce barriers that tend to cause students to drop out of mathematics programs or not to enter mathematics programs.

Major curriculum efforts have been focused on the first two years of college mathematics. The National Science Foundation (NSF) has awarded grants to institutions and consortia to develop new materials that can be used at a variety of institutions. Among the projects being supported are those at Harvard University in Massachusetts (a nationwide project related to calculus; contact Andrew Gleason); Macalester College in Minnesota (a calculus project; contact A. Wayne Roberts); Dartmouth College in New Hampshire (a calculus project involving computers; contact Richard H. Crowell); Duke University in North Carolina (a calculus project emphasizing laboratory activities; contact Lawrence C. Moore); and the University of Rhode Island (a calculus project involving use of computers; contact Edmund A. Lamagna).

The first year sequence is being reviewed and modified at many two-year and four-year institutions. Two-year institutions are modifying courses to make courses more current and to improve the transfer status of their students. Four-year schools are modifying course sequences to make content more current and to take advantage of new technology. A major addition to many first year sequences is discrete mathematics. While discrete mathematics is being offered by many institutions, some who have included it in their curriculum on a trial basis have reverted back to their previous course patterns.

Many institutions are working to modify the content of calculus courses and the calculus sequence. Alternative

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courses are currently being taken by over 30 percent of calculus students. Alternative textbooks for calculus such as one developed by the Institute for Electrical and Electronic Engineers (IEEE) are being used in some courses. Other alternative materials are being used and new materials are being developed.

The use of technology has increased substantially in college mathematics courses during the past few years. The technology has been used for (1) instructional purposes such as computer assisted and computer managed instruction and (2) as tools for doing mathematics.

Several institutions, including the Department of Mathematics at The Ohio State University, have developed courses and materials to make better use of graphic calculators and graphics on computers.

Symbolic algebra packages, such as MACSYMA, SMP, and MAPLE, allow students to work much more sophisticated problems than they could without the software. These materials are being used at many institutions and are helping them to make some significant modifications in course design and instruction.

Several institutions have also been modifying mathematics courses based on learning theory. Jack Lockhead and colleagues at The University of Massachusetts have modified mathematics courses to stress a constructivist learning approach. Through instructional activities students are helped to develop (construct) their own concepts and understandings.

Investigators and instructors in mathematics at the University of California in Berkeley have been investigating how students learn mathematics and how instruction and materials can be modified to improve learning.

What are some current developments in college mathematics programs, courses, and materials for nonmajors?

The need for mathematics is also important for nonmajors. Two types of courses are the focus of several institutions: (1) introductory courses for nonmajors who will not take higher level mathematics courses and (2) courses for physical science majors, computer science majors and others who will take higher level mathematics courses.

Introductory courses are being developed and modified to stress major concepts, applications, and topics such as statistics, functions, reasoning, problem solving, and communication. Efforts are also being made to design some introductory courses to reduce math anxiety and to encourage the student to enroll in more mathematics.

Courses for client groups that take higher level mathematics are being modified to reflect concepts, skills, and applications used by the client groups in addition to providing general mathematics. Mathematics courses for computer science majors, engineering majors, business education majors, physics majors, and chemistry majors are among those that have been modified at several institutions.

Selected Sources of Information on College Level Developments in Mathematics

American Mathematical Association of Two-Year Colleges (AMATYC)
Parkland Community College
2400 West Bradley Ave.
Champaign, IL 61821
(217) 351-2225

American Mathematical Society
P.O. Box 6248
Providence, RI 02940
(401) 272-9500

Consortium for Mathematics and Its Applications (COMAP, Inc.)
60 Lowell Street
Arlington, MA 02174
(617) 641-2600

Mathematical Association of America
1529 - 18th St., NW
Washington, DC 20036
(202) 387-5200

Mathematical Sciences Education Board
818 Connecticut Ave., NW, Suite 500
Washington, DC 20006
(202) 334-3294

The National Council of Teachers of Mathematics
1906 Association Drive
Reston, VA 22091
(703) 620-9840

The National Science Foundation
Undergraduate Program
1800 G Street, NW
Washington, DC 20550
(202) 357-7557

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